

Opinion. Opinion is intended to promote communication between lepidopterists resulting from the content of speculative papers. Comments, viewpoints and suggestions on any issues of lepidopterology may be included. Contributions should be as concise as possible and may include data. Reference should be limited to work basic to the topic.

Are We Studying Our Endangered Butterflies to Death?

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A number of studies suggest that handling has adverse effects on butterflies. Singer and Wedlake (1981), for instance, were able to recapture only 2% of the *Graphium sarpedon* that had been captured, marked, and released on a riverside beach in Sarawak. Subsequently, they were able to mark the swallowtails without handling.

"The procedure employed was to crawl towards the insects extremely slowly, taking several minutes to reach them. On the first occasion that this was tried, the marker pen was held in an outstretched hand, but it was found to have dried out by the time it reached the feeding butterflies. Subsequently we wormed our way up the beach on our stomachs with both hands outstretched, so that we could delay uncapping the pen until after its arrival among the butterflies."

After using these methods, Singer and Wedlake found that recapture rates soared to 21%. Morton (1984) in a temperate zone study likewise found that marking the lycaenids *Polyommatus icarus* and *Lysandra coridon*, without handling, also resulted in increased recapture rates.

Direct impact of handling on butterfly behavior and longevity, however, has been difficult to document. Powell (pers. com.) has observed that freshly emerged adults of the endangered Lange's metalmark butterfly (*Apodemia mormo langei*) assume their nocturnal resting position when marked immediately after emerging from their pupae. Some individuals retain this position for extended periods which could subject them to higher rates of predation. Reid (1985 and pers. comm.) found that handling of the endangered mission blue butterfly (*Plebejus icarioides missionensis*) results in about 10% mortality. He has for that reason discontinued the use of mark-recapture techniques in long-term studies on San Bruno Mountain. Many field workers suggest that mark-recapture methods probably should never be employed with small-winged, swift-flying species, for example the threatened Pawnee

montane skipper (*Hesperia leonardus montana*) presently under study in Colorado.

Despite this mounting evidence that many butterflies exhibit greatly disturbed behavior or suffer physical damage from marking and recapture, mark-recapture remains one of the initial steps in nearly every conservation effort focussing on butterflies. This is especially ill-advised because the data obtained from such studies rarely are useful in the protection of endangered species. For instance, mark-recapture studies and intensive statistical analysis have revealed few differences in population parameters between the gravely endangered bay checker-spot butterfly (*Euphydryas editha bayensis*) and the widespread chalcid checkerspot (*Euphydryas chalcedona chalcedona*) on Jasper Ridge Biological Preserve at Stanford University (Murphy, et al. 1986). The study suggested that "new approaches both to mark-recapture analysis and the study of endangered species are needed to generate more useful information concerning the conservation status of invertebrate populations." Murphy et al. further conclude that methodologies which minimize physical damage to butterflies and their habitats should be emphasized when studying endangered or threatened species.

The limits of distributions and relative densities of butterflies within their habitats constitute the critical information usually sought by conservation biologists. This information nearly always can be ascertained through simple observation and use of a low impact "sampling" technique such as that of Pollard (1977), which involves repeatedly walking transects while recording the number of butterflies observed. The purported advantage of mark-recapture techniques over transect observations lies in the estimate of absolute (rather than relative) population sizes which may be generated from field data. But this advantage usually is moot since endangered butterflies are virtually always restricted to small habitat patches where population sizes are small. Little practical value is gained from establishing that populations that are obviously small are indeed small.

Two additional problems are prevalent when mark-recapture techniques are used to derive population size estimates for conservation studies. First, the variances associated with these estimates are often as large as the population estimates themselves. The only way to reduce that variance is to increase the handling, marking, and recapturing of the endangered butterflies. Second, exact population size is relatively unimportant when developing conservation agendas. For example, the entire two acres of habitat owned by Chevron Oil, in Southern California, must be protected and maintained free of alien plant species to ensure the persistence of the El Segundo blue butterfly, whether 100, 300, or 1,000 individuals are present in any given year.

If mark-recapture studies offer little guidance in conservation efforts, why then are they allowed—and even promoted? The answer may rest in the fact that most studies are commissioned in response to govern-

ment regulations which require private land developers to assess the potential impact of proposed habitat disturbance to endangered species. The lead agency in these situations is either the United States Fish and Wildlife Service or a state agency with a similar mandate for species protection. Limited by tight budgets and small staffs emphasizing fish and game resource management, these agencies often must seek advice from outside "experts," especially on matters pertaining to invertebrate conservation. Many consultants take advantage of this situation to promote more labor-intensive (read 'more expensive') field methodologies, such as mark-recapture studies, when simpler approaches are adequate to achieve most conservation objectives.

A particularly egregious example is a recent study involving the federally protected Smith's blue butterfly (*Euphilotes enoptes smithi*) on Marina State Beach in Monterey County, California (Arnold, 1986). This study proposed no new approach to the management of this endangered butterfly, yet it potentially subjected a population to severe impacts from handling. Nominally trained "students" were used to mark more than 400 adult blue butterflies, which together subsequently were handled another several hundred times. The stated objectives of the study were "to 1) determine the present distribution and population numbers of Smith's blue, at Marina State Beach; 2) determine which habitat areas of the dunes are important for mate location, foraging, and larval development; 3) evaluate different census methods for their appropriateness in future monitoring of Smith's blue during and after implementation of the revegetation program; and 4) provide management recommendations for Smith's blue at Marina State Beach."

As discussed above, the first and second goals largely could be met by simple survey and transect procedures, without handling butterflies. To use the most fragile, federally protected butterfly species as a lepidopteran guinea pig in pursuit of the third goal defies any sense of logic or conscience. Certainly a non-endangered, taxonomically related species could have been used to develop a low impact protocol for application to an endangered species. The fourth goal underscores the lack of pertinence of most mark-recapture studies to habitat management. The key recommendations stated at the conclusion of the study were "to control, and where feasible, eradicate alien flora that can outcompete native vegetation such as the butterfly's buckwheat foodplants" and to "promote natural dune dynamics, which facilitates natural seeding establishment by the native flora." Not only were those recommendations obvious from a cursory view of dunes blanketed with South African iceplant, but just such a restoration project was already in process. In other words, hundreds of endangered butterflies were subjected to physical impairment and potential mortality associated with handling for no good reason.

All this does not mean that no value whatsoever can be derived from mark-recapture studies of endangered butterfly species. Interha-

bitat dispersal can be crucial to the overall persistence of butterflies where adjacent populations exist or empty (but suitable) habitat patches are available. Gall (1984), for instance, used mark-recapture to demonstrate age-dependent dispersal in female *Boloria acrocnema* in an isolated Rocky Mountain habitat patch. He speculated that late season female dispersal may contribute to the colonization of new habitat patches. But one must ask whether similar insights into the population dynamics of species less physically hardy than *Boloria acrocnema* warrant the potential damage from intensive handling. I contend that they do not.

This paper is presented as a plea to government agencies, environmental consultants, and field biologists to restrict mark-recapture studies to non-endangered species, or to endangered species proven hardy enough to withstand human handling. In the latter circumstances, mark-recapture should be employed only to answer specific questions crucial to recovery strategies. The use of untrained field workers in such studies should be strongly discouraged. The preponderance of evidence indicates that the handling of lycaenid butterflies, in particular, usually results in the taking of individuals—an unlawful act under most permits to handle endangered species and one which should not be encouraged in the name of conservation.

It seems the ultimate irony that recent attempts at conserving our butterflies often have amounted to studying them to death.

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